Baseline Habitat Evaluation and Evaluation of the Impacts of City Activities

Prepared for:

City of Corvallis, Oregon

February 12, 2002

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This document is not intended to be a complete inventory of Corvallis stream and riparian areas. Rather it provides a sufficient chinook salmon habitat baseline and analysis of the effects of City activities on that baseline, to ensure compliance with the ESA Section 4(d) Rules as written by the National Marine Fisheries Service.

EXECUTIVE SUMMARY

The final Endangered Species Act (ESA) 4(d) Rules released in the Federal Register July 10, 2000, pose challenges to cities such as Corvallis. The following is a brief discussion of the challenges and risks the final rules may present to the City of Corvallis (City) and the proposed methodology to identify, evaluate, and quantify the impacts on chinook salmon habitat from City government and private citizen activities and behaviors.

Under the 4(d) Rules, Corvallis is required to develop a program that will protect the listed species of chinook in the upper Willamette Basin. The rules have far-reaching implications for City activities, including design, operation, and maintenance of public works; land use; parks and recreation; private development; and public development activities.

Section 9 of the ESA prohibits taking species listed as threatened and endangered. The term “take” is broadly defined to include any activity that harms or kills listed species. The National Marine Fisheries Service (NMFS) recently defined the term “harm” to include significant habitat modification or degradation that actually kills or injures listed species by significantly impairing essential behavioral patterns. These essential behavioral patterns may include spawning, rearing, and migration.

Section 4(d) of the ESA provides that NMFS may adopt regulations it deems necessary for the conservation of threatened species. The NMFS 4(d) Rules identify activities the agency believes may constitute a take of listed species. The rules also identify activities that “conserve” listed species; that is, activities conducted pursuant to NMFS-approved land use regulations. The rules identify 13 activities or programs that NMFS believes will limit impacts on salmonid species, so added protection through application of ESA Section 9 will be unnecessary.

The pathways analysis is the scientific approach that the City of Corvallis has taken to evaluate activities within the urban growth boundary (UGB; see Figure 1, Location and Study Area Map). It is the result of careful review of the Section 4(d) plan regulations and detailed discussions with NMFS staff scientists and was created to provide a methodology that will achieve the Section 4(d) Rule objectives. The pathways analysis seeks to assess the impact on chinook salmon habitat by identifying the link between the activity (e.g., City-provided infrastructure services, activities, and the regulations and codes that regulate these activities; and private citizen behavior), and the chinook salmon habitat. This so-called pathway or conveyance is the way an activity can affect the habitat.

Figure 1: Location and Study Area Map

Click on evaluation Figure 1 on documents page to view project location map.

Ecological Risk and Take Issues

The analysis begins with an assessment of the ecological risks associated with take. Take, with respect to this project, is defined as those actions having a direct or indirect effect on the individual fish or habitat. They include killing or otherwise harming, harassing, or preventing the fish from carrying out its normal biological activities**.** The diverse and variable life histories of salmonid species create a number of problems for any agency wishing to develop a protection program. To determine the level of protection afforded a species, it is necessary first to assess the nature of risk to each life history stage.

Changes in stream structure that produce temperature changes (see below) also influence dissolved oxygen levels. A combination of decreased flows, increased shallow pools, and higher temperatures produces lowered dissolved oxygen concentrations. This increases the stress on fish and could result in decreased life expectancy. Increases in nutrients produced by fertilizers and other organic materials transported into the stream by runoff also may cause increased algal or macrophyte production. Vegetation die-offs, whether natural or caused by herbicides transported into the system, and the resultant breakdown of this organic material, also cause a decrease in dissolved oxygen in the stream. The introduction of herbicides, pesticides, and other potentially toxic materials into the aquatic ecosystem could result in diminished production or mortality of any or all levels of the food chain.

Take of critical habitat occurs regardless of the presence of listed species. The National Marine Fisheries Service identified the key habitat concern to be “properly functioning condition” (PFC). Properly functioning condition refers to stream processes that closely approximate historical conditions. In its final ESA 4(d) Rules, NMFS states that it does not expect cities to attain PFC immediately, but that they should show progress toward attainment. This ruling allows cities to classify aquatic habitat into three categories: areas to be protected (e.g., spawning and rearing habitats), areas to be maintained (i.e., protected from further degradation), and areas that may require rehabilitation (e.g., areas that contain barriers to fish passage and areas channelized or otherwise modified).

Habitat types of interest include spawning habitat, rearing habitat, and movement corridors. Spawning habitats generally consist of riffle or pool tail-out areas with a high percentage of gravel substrate. Rearing habitat contains moderately sized pools with overhead cover. Barriers include impassable culverts, pop-up or other dams, and dewatered areas. Other habitat elements directly influenced by City activities include temperature, turbidity, and food supply.

Spawning areas are threatened by sedimentation, a “flashy” hydrograph (water flow over time), and temperature. Sedimentation fills in the small spaces in spawning beds, thereby exposing the eggs to the risk of insufficient oxygen for survival. A “flashy” hydrograph, one with higher highs and lower lows, influences spawning by flushing spawning gravel with higher flows than normal and by holding fish lower in the system during low-water periods. Water temperatures higher than those preferred result in higher stress levels and resultant transfers of energy to metabolic maintenance and away from activities such as growth and reproduction. They also can cause higher egg and larval mortalities. A number of activities can raise water temperature, including high temperature inputs from outside the system, conversion of riffle areas to pools, and removal of riparian cover. Salmonids prefer relatively low water temperatures and are therefore among the first fish to be affected by even small temperature changes.

Loss of cover also contributes to changes in stream structure and threats to rearing habitat. Removal of riparian cover leaves streambanks susceptible to both instream erosion and erosion from water entering the stream. It reduces shade, causing water temperatures to increase, and removes the sources of large woody debris.

Many culverts that were constructed in the years prior to the listing of salmonid species either stop or impede fish movement, causing a change in their normal behavior patterns. This constitutes a "take". So also is stream channelization that acts as a barrier to fish movement. Actions that influence the food chains or webs utilized by listed species, thereby resulting in diminished growth and/or reproductive opportunities for individual fish, has been interpreted as a take under ESA rules.

Baseline Analysis

The next element is an analysis of the baseline features of the streams in the study area. Each stream is summarized in the body of the report. The streams in the Corvallis area, with the exception of the Willamette River, contain no listed species. Nor is there any historical record of spawning or rearing in any of them. It is likely, given their size, hydrology, and geomorphology, that they never have been "chinook" streams. Impacts to spawning and rearing areas, therefore, are not critical elements in determining the potential for take resulting from actions by the City.

Despite this, the streams play a role in the baseline water quality of the Willamette River. Water quality is likely the area most important to fish migrating past Corvallis. Riparian functions also are critical—as shade sources to decrease temperatures, as filters for removing contaminants, and as stabilizers to help prevent instream and bank erosion. In the lower reaches of the streams, riparian areas have been severely diminished by development (Figure 2; Reach Locations Draft). Channelization is another result of increased development. The need for streams to become stormwater conduits serves to further contribute to incision and diminishes and eventually removes altogether the floodplain connectivity of the system. The streams also have served as high-water refuge habitat. Barriers at their mouths impede this use. Therefore, impacts from contaminants, impervious surfaces, riparian buffers, and instream habitat conditions (erosion and excessive sedimentation) all play critical roles in the determination of water quality. The result of all this activity, along with the basic human activities associated with living, is diminished water quality in these streams. Eventually this makes its way to the Willamette River, where it can become a take.

The Willamette River differs from the other streams, however, as both immigrating adults and emigrating juveniles use the reach at Corvallis as a passageway. Adults move upstream from April through June and juveniles move downstream from February through May. Some additional movement occurs in October and November. It may be that some use the off-channel habitat on the east side of the river as a resting area. The migratory use of the river makes activities that affect the Willamette more critical in terms of take of listed species.

Figure 2: Reach Locations Draft

Click on evaluation Figure 2 on documents page to view stream reach locations.

It is clear from the available data that the baselines of all the streams, including the Willamette River, are degraded considerably from their probable condition prior to human settlement. They are urban streams and show all of the attendant characteristics. The channels are incised and straightened and the riparian buffers are reduced in size, continuity, and composition. Off-channel habitat in the Willamette River has become considerably reduced or disappeared altogether. While this plays a lesser role in the establishment of the baseline condition, the distinction becomes more important when a trajectory for recovery is considered.

Analysis of City Activities

After the summary of the baseline habitat condition, the report summarizes the effects of City activities—both regulatory and infrastructure—and the pathways through which these activities affect the baseline. City infrastructure activities, including stormwater and wastewater systems, potable water systems, street cleaning, and transportation elements, significantly impact the habitat baseline. All pathways are implicated in these effects.

Stormwater

The stormwater collection and conveyance system is perhaps the most obvious in terms of its influence, and likely the most far-reaching, as it is the conveyance for a number of the other activities as well. Chief among these is the impact upon the streams by changes to the hydrograph. The number of outfalls in the system and the relatively little onsite detention means that the greatest amount of stormwater acts as Hortonian overland flow into the streams, rather than percolating and entering the streams gradually through the groundwater system. This changes the instream fish habitat and alters flows and erosion/deposition patterns. Since the streams around Corvallis are part of a closed system, the most negative effect is the increased sedimentation rate brought about by increased velocity or decreased infiltration. The pathways also are affected by temperature changes: through the warming of water in either detention facilities or shallow pools that form when flows are low during the non-rainy season.

The elements of the stormwater system that negatively affect the pathways are culverts which pose a barrier to fish movement (also a transportation impact) and fertilizers, herbicides, and pesticides for vegetation control and maintenance along ditches and streams. Other contaminants and sediments are introduced into the system through the flushing process. Ditch-mowing, too, contributes to runoff and the introduction of contaminants.

Wastewater

Wastewater impact pathways include the introduction of contaminants and alteration of temperature. There are a number of potential scenarios involving spills and discharges that would introduce raw pollutants or treatment chemicals directly into the system (e.g., spills, overflows, leaking pipes, and pumping system failures). This type of discharge could have both directly toxic and sublethal effects on the fish themselves, but habitat impacts are likely to be negligible. New construction (such as the pipelines the City is planning along stream systems) would have impacts related to the construction, such as increased sedimentation and erosion, and impacts related to the removal of riparian vegetation (the buffer pathway), such as increased temperatures as a result of the loss of shading.

Drinking Water

The potable water system is affected when raw water is withdrawn (instream habitat pathway) and then returned to the system through the wastewater and stormwater systems, causing changes in flows. The dam across Rock Creek (barrier and flow alterations) also affects drinking water, though it probably is not a barrier to listed species. Chemical contaminants are introduced into the system via the use of fertilizers, pesticides, and herbicides for maintenance along watercourses; the backwashing of water filters; and the flushing of pipes. Scheduling becomes critical because maintenance performed during low water conditions does not benefit from dilution effects, making impacts that much greater.

Transportation

The two major areas of transportation-related impact are new construction and maintenance. New construction includes actual construction activities, the road itself, increased traffic, and increased maintenance. Construction within the corridor will have immediate impacts resulting from increased erosion related to the construction activities, increased impervious surface and resultant stormwater runoff-related changes to the hydrograph, and inputs of contaminants from the road surface. The continuity, composition, and width of the riparian vegetation buffer also will be affected.

Construction outside the stream corridor can still have negative impacts through the impervious surface and contaminant pathways. In addition to changes in the stream hydrograph and the introduction of contaminants mentioned above, an increase in the amount of road surface enables an increase in traffic, leading to more contaminants on the road surface.

Similar impacts to the habitat baseline result from the existing transportation system. Contaminants enter the stormwater system from roadways. Maintenance associated with de-icing roads introduces contaminants either directly into the system or into the stormwater system, with the same eventual destination. Similarly, the use of any pesticides, herbicides, and fertilizers, either along the watercourses or in areas where the effluent is conveyed by the stormwater system, have a negative effect on fish in the system and on critical habitat through effects on the food supply. Roadside mowing decreases the ability of the vegetation to slow overland flow and allow the stormwater to percolate. Bridge washing uses detergents that may have some toxic or sublethal effect on fish or their food organisms.

Road repair uses petroleum-based compounds that could be transported into the stormwater system and then to the stream itself, creating a toxic situation. Bridge repairs and painting may introduce substances of unknown toxicity into the systems directly. Culvert cleaning and repair are likely to introduce sediments into the stormwater or stream systems, causing an increase in total suspended solids. These impacts are likely to be sublethal in nature, influencing feeding and navigation capabilities.

Parks

An analysis of park planning, construction, and maintenance indicates two major pathways for impacts on fish habitat: impervious surfaces and contaminants. Parks have an impact on habitat through their design and maintenance. Design elements include trails, parking lots, park structures, and playing fields. All of these modify conditions to some degree, as they can become impervious surfaces. Since parks have no stormwater facilities, most impervious surface contributes to sheet flow into the streams. While it is likely that some sod areas have some infiltration of stormwater, asphalt and heavily compacted dirt, gravel, and grassy surfaces (particularly mown grass) effectively increase sheet flow into the streams so that use of the park itself becomes an issue.

Pesticides, herbicides, and fertilizers, while useful for park maintenance, become contaminants in the stream system. Such nutrients flow into the system through runoff and enhance the potential for eutrophication. Pesticides and herbicides are generally considered to be toxic or to have sublethal effects. These chemicals, when used to maintain park areas near streams, will have a direct effect, even though methods of dispersal are localized. Indirect effects occur as the result of sheet-flow runoff from parts of the park system outside the riparian corridor.

The effects of new parks (park planning) on fish habitat use the same two pathways. New construction also may commit a direct take on critical habitat through placement in the riparian zones or by usurping other hydrologic features (e.g., wetlands).

On the other hand, positive (or neutral) impacts to the baseline also may be incorporated in design. Such elements as stormwater treatment swales and water quality strips along riparian zones would serve to maintain PFC, if not actually enhance it. It also may be possible to incorporate restoration actions into new park design, making the parks positive contributors to obtaining PFC.

Land use

The greatest impacts on the habitat baseline occur, obviously, in the land use arena. All pathways are implicated, both directly and indirectly. Any development in the area increases the amount of impervious surface (i.e., buildings, parking lots, driveways, streets and roads, etc.). The intensity of the impact depends upon the footprint of the development and the level of treatment, if any, of the associated stormwater runoff.

Development also affects the riparian buffer. Crossings and structural encroachments break continuity and species composition is changed, sometimes quite radically. Removal of the trees (e.g., replacing an oak gallery forest with maintained lawns) decreases a great many of the functions of a riparian system, especially those associated with water quality—temperature and filtering. Even a lawn, if compacted sufficiently, can act as an impervious surface, and the grass may be too short to be effective as a filter strip or as shade.

Instream habitat also is affected by development. The streams are separated from their floodplains, as it is not desired that they cause property damage by flooding, and they become stormwater conduits that move water rapidly through the area to the Willamette River. Streams also are constrained by infrastructure development—streets and culverts—which act as barriers, another pathway to habitat impacts.

Daily activities associated with human occupation contribute to the contaminant pathway. Fertilizers, pesticides, and herbicides are commonly used (See Dixon Creek for a list of chemicals found in the stream and their uses). Liquid and solid petroleum products, heavy metals, and bacteria also enter the stream systems and affect the baseline. These are considered to be a standard constituent of any urban stream.

It is important to discern differences in intensity of land use for residential, industrial, and commercial areas. For instance, residential low-density housing may have a greater impact on fish habitat because of yard-maintenance. Higher residential density may have more impervious surface and, therefore, more run-off. Industrial land use could be heavy or light and, depending on the activity, could have different impacts. The same is true for commercial land use. The degree of impact is much like residential: it depends in part on the footprint of the development and any mitigation. No codes mandate stormwater treatment and percolation. The structure of the codes serves only to decrease the impact to the environmental baseline by controlling the impervious footprint on a lot; it does not maintain or improve that baseline.

Zoning, by designating land use, determines the extent of impact on the baseline. While it does not necessarily mean that all land in a particular zone is of the type zoned, it does suggest what may occur in the future. Activities in the riparian corridor will have a continued detrimental effect on habitat by way of the riparian buffer pathway because they will affect buffer size, continuity, and species composition, and they will increase impervious surface and contaminant runoff. Activities outside the riparian corridor may not necessarily have this impact, but the potential is there if any of the pathways are operating. As can be seen in the analysis, these pathways are found in most of the development-based activities.

Land Use Development Code

The Comprehensive Plan for the City of Corvallis serves as the projection of development activities. It is the City's most critical land use document, containing various measures designed to (1) permit development in some areas, (2) preserve other areas (e.g, open space, agricultural land, forestry resources, and buffers), and (3) restrict development on sensitive lands, for example, hillsides and floodplains. The plan protects resources such as waterways, riparian zones, forests, and wetlands identified as significant. It also restricts stormwater impacts to such elements as water quality, establishing that they may become no worse than pre-development conditions. The Plan also addresses contaminants and other pathways.

The development code determines what is allowed in development, zoning, etc. It is the Comprehensive Plan made operational. Little of the code addresses habitat impact pathways, although elements mentioned above do specifically preserve riparian corridors and open spaces. Other positive elements are those that limit certain of the pathways, such as impervious surface. However, these do not stop the effects of the activity, but only limit the increase (as above). This still causes an increase in the effects on the habitat and further degrades the baseline. The recent nature of the City of Corvallis' Comprehensive Plan is reflected in the fact that the development code has not yet been formulated and implemented.

Conclusion

It is clear from this analysis that the majority of City activities, through any and all of the pathways, have a negative effect on the habitat conditions in the streams of the project area. The greatest impact comes from impervious surface, followed by riparian buffer changes and channelization. Impervious surface results not from just the construction of buildings, streets and roads, and parking areas, but also from such seemingly benign activities as trails and parks. The increased runoff is particularly important in the upper reaches of the Corvallis streams (especially Dixon, Oak, and Squaw). While it also is also important on Sequoia, this stream is not crucial as critical habitat for listed species because of the filtering capacity and passage barrier aspects of the Jackson-Frazier wetland complex. While the lower reaches of the other streams are likely completely incised or nearly so, the upper reaches still retain a great deal of function and hydrologic connectivity. This is likely to change as these areas are designated for increased development and the additional impervious surface that will result.

The City has criteria within its comprehensive and other plans that address the Municipal, Residential, Commercial, and Industrial (MRCI) limits. As such, these elements provide the framework for Phase 2 of this plan: the determination of solutions to the impacts identified in this report.